ALASKA FISHERIES SCIENCE CENTER

EFFECTS OF FISHING GEAR ON SEAFLOOR HABITAT PROGRESS REPORT FOR FY 2002

edited by

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In 1996, the Alaska Fisheries Science Center (AFSC) initiated a number of seafloor habitat studies directed at investigating the impact of fishing on the seafloor and evaluation of technology to determine bottom habitat type. A progress report for each of the major projects is included below. A list of publications that have resulted from these projects is also included. Scientists primarily from the Auke Bay Laboratory (ABL) and the Resource Assessment and Conservation Engineering (RACE) Divisions of the AFSC have been conducting this work. A web page (http://www.afsc.noaa.gov/abl/MarFish/geareffects) has been developed that highlights these research efforts. Included in this web page is a searchable bibliography on the effects of mobile fishing gear on benthic habitats.

Exploration of coral and sponge habitat in the Aleutian Islands Principal Investigators Robert Stone and Jonathan Heifetz (Alaska Fisheries Science Center - ABL)

In July 2002, scientists used the manned submersible *DSV Delta* and scuba to explore coral and sponge habitat in the Aleutian Islands near the Andreanof Islands and on Petrel Bank (Figure 1). Dive observations confirmed that coral and sponges are widely distributed in that region; corals and sponges

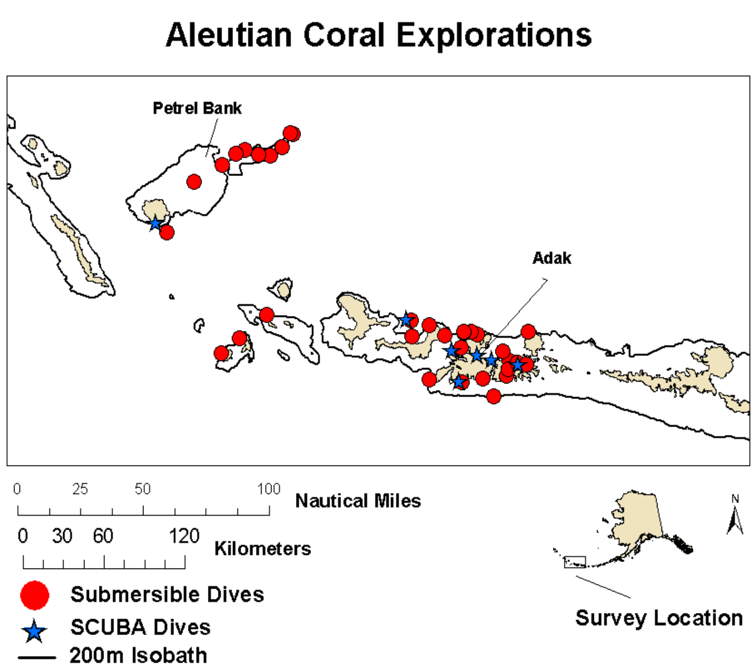

Figure 1. Submersible and scuba dive locations near the Andreanof Islands and Petrel Bank.

were found at 30 of 31 submersible dive sites. Disturbance to epifauna, likely anthropogenically induced, was observed at most dive sites and may have been more evident in heavily fished areas. Percent coverage of corals ranged from approximately 5% on low-relief pebble substrate to 100% coverage on high-relief bedrock outcrops. Unique coral habitat consisting of high density "gardens" of corals, sponges, and other sessile invertebrates was found at 5 sites between 150 and 350 m depth. These "gardens" were similar in structural complexity to tropical coral reefs and shared several important characteristics with tropical reefs including complex vertical relief and high taxonomic diversity.

A model for evaluating fishery impacts on habitat Principal investigators - Jeffrey Fujioka and Craig Rose (Alaska Fisheries Science Center - ABL and RACE)

The final regulations for essential fish habitat (EFH) require Councils to act if a fishing activity adversely affects EFH in a manner that is "more than minimal and not temporary in nature .....". Lacking further guidance from NMFS Habitat Office, the North Pacific Fishery Management Council's EFH Committee asked scientists of the Alaska Fisheries Science Center to provide guidance on criteria for determining "minimal" and "temporary". After considerable deliberation, it became clear a basic logical mathematically consistent framework was needed to evaluate fishery impact.

The term "temporary" was considered as a qualitative description associated with a high rate at which a habitat recovers from an impact and the term "minimal" as a low rate at which a habitat is impacted. Since we are primarily concerned with the net result of a habitat's recovery rate and the rate at which it is impacted, differential equations were used to model recovery rate and impact rates on habitat, and compute the level of impacted and unimpacted habitat over time. At constant rates of recovery and impact, equilibrium levels of impacted and unimpacted habitat would be reached.

Habitat was assumed be in two different conditions or states: H = unimpacted habitat, h = impacted habitat. I = the rate at which habitat is impacted, and ρ = recovery rate of impacted habitat back to an unimpacted condition. Impact rate, I, decreases the amount of unimpacted habitat, H, over time in the same way instantaneous fishing rate, F, decreases the amount of fish over time and can be parameterized similarly. In the absence of any habitat recovery, H would decrease exponentially just as a closed fish population would decrease under constant F. F is expressed as F= f q where f = fishing effort and q = catchability coefficient and I can be expressed as $I = f\, q_H$ for the same f and q_H = habitat impact coefficient per unit effort.

Recovery rate, ρ , reflects the rate of change of impacted habitat, h, back to unimpacted habitat, H. In the absence of further impacts, h would decrease exponentially till all habitat was in H, the unimpacted condition. The recovery time, R, can be thought of as the average amount of time the impacted habitat stays in the impacted state, which would equal $1/\rho$ (in the absence of further impacts). Each habitat type has different recovery times.

Integrating the differential equations, we get an equilibrium proportion of unimpacted habitat at $t = \infty$:

$$H'_{equil.} = \rho S/(I + \rho S) .$$

$$S = e^{-I}$$

It can be seen as the impact rate I increases, H_{equil} occurs at a lower level, while a higher recovery rate, ρ, results in a higher level of H_{equil}. Both impact rate and recovery rate are necessary to determine the degree of impact, the level of H_{eq}. The terms temporary and minimal alone do not reflect the degree of impact. A recovery rate would have to be extremely high (temporary) to declare any impact to be insignificant without considering the corresponding impact rate. It takes recovery rates greater than ρ =1.0 (or average recovery times less than 1 year) to keep H_{eq} above 80% of H_0 at *I*'s approaching the upper range of F's reported in the NPFMC groundfish fisheries. Thus, if an impact that qualifies as temporary need not be considered as possibly adverse regardless of impact rate, temporary should be considered as having a recovery rate equal to more than 1.0 (Even at ρ =1.00, only 63% of the habitat will recover in one year). Likewise, it takes an extremely low rate to result in an insignificant reduction in H_{eq} if recovery rate is low.

The parameterization of fishing impact allows effort data from the Observer Program to be utilized. While the lack of information on the habitat impact per unit of effort, recovery rates of different habitat or habitat features, and the distribution of bottom habitat will likely prevent definitive conclusions, the model provides a mathematically consistent framework to unify the elements of fishing impacts on habitat. Currently applied analyses are underway for the evaluation and development of alternatives for mitigating impacts of NPFMC fisheries. The analyses provides estimates of the reduction habitat features ($1-H'_{eq}$) for different fisheries conditional on assumed values of impact per unit of effort, recovery rates, and habitat distribution.

Ecological consequences of lost habitat structure for juvenile flatfishes Principal Investigator – Allan W. Stoner (Alaska Fisheries Science Center - RACE)

Distributions of flatfishes are ordinarily associated with depth, temperature, and sediment type. However, recent descriptive and experimental studies have shown that some juvenile flatfishes have strong preferences for habitats with physical structure created by large epibenthic invertebrates, biogenic structures in the sediment, and sand waves. For example, beam trawl collections made in nearshore areas of Kodiak Island during July 2002, revealed that densities of age-0 rock sole and age-0 Pacific halibut were correlated with habitat structure provided by empty shells and sedentary invertebrates collected as bycatch in the tows.

New laboratory experiments indicate that reductions in habitat heterogeneity may have important ecological consequences for flatfishes, through both direct and indirect mechanisms. First, some flatfishes have a preference for structured habitats. Juveniles of northern rock sole and Pacific halibut were offered pairwise choices of smooth bare sand and habitats with physical structure (sand plus sponges, bryozoans, bivalve shells, or sand waves). Age-0+ and age-1+ fish of both species had strong preferences for the structured habitats regardless of structure type. Second, structured habitats can reduce mortality rates on juvenile flatfishes. Predation rates by age-2+ halibut on age-0+ rock sole and halibut were tested in large laboratory mesocosms with and without physical structure, in this case smooth bare sand versus sand plus sponges. Mortality rates for both prey species were significantly higher in the sand habitat than in the structured habitat. Age-0+ halibut were encountered by the predators 4 times more frequently in sand than in sponges. The difference in encounter rates with rock sole were not significant; however, the numbers of prey captured per unit effort were significantly lower in the sponge habitat than in bare sand for both rock sole and halibut prey.

The laboratory findings are being examined in light of invertebrate bycatch data collected from heavily trawled and untrawled areas straddling the northeast boundary of Crab and Halibut Protection Zone 1 (CHPZ1) in the eastern Bering Sea, which serves as an important nursery ground for flatfishes. Sedentary macrofauna such as anemones, soft corals, sponges, gastropod eggs, bryozoans, and ascidians, and whelks and empty mollusc shells that provide habitat for small flatfishes were all more abundant in the unfished area.

Trawl impact studies in the Eastern Bering Sea Principal Investigator - Robert A. McConnaughey (Alaska Fisheries Science Center - RACE)

This study is being conducted to experimentally investigate possible adverse effects of bottom trawls on a soft-bottom area of the eastern Bering Sea and to evaluate a state of the art side scan sonar and swath bathymetry system for mapping benthic habitats. Whereas earlier work focused on chronic effects of trawling, the present multi-year study is a process-oriented investigation of short-term effects and recovery using a BACI experimental design. In 2001, 12 10-mi long research corridors were surveyed before and after trawling with commercial gear (NETS 91/140 Aleutian cod combination). To investigate the recovery process, these same corridors were resampled in 2002 during a 21-day cruise aboard the 155' trawler *F/V Ocean Explorer*. All scientific systems were successfully implemented on the chartered vessel, including an ultra-short baseline (USBL) tracking system, two complete side scan sonar systems with tow winches, a trawl mensuration system, and a survey-grade integrated navigation system with DGPS, two gyroscopic compasses and a vertical reference unit. All systems were tested and calibrated during the 6-7 June gear trials in Puget Sound. During the June 18- July 8 Alaska cruise, biological, physical and chemical characteristics of the seabed were randomly sampled in six experimental-control corridor pairs (Fig. 2). Biological sampling consisted of 15-min research trawls for

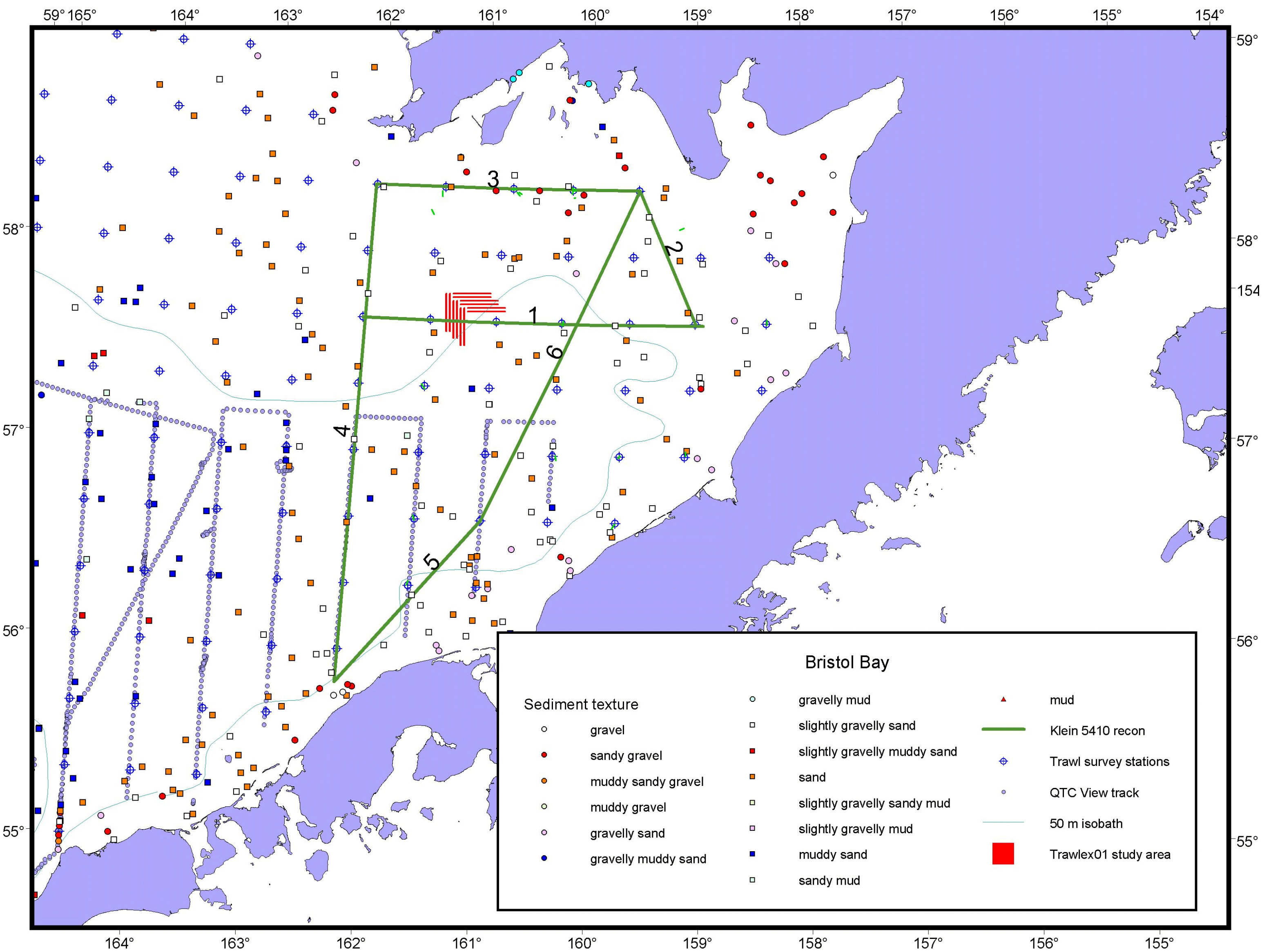

Figure 2. Location of the 12 research corridors and the 6 reconnaissance tracklines in Bristol Bay on the eastern Bering Sea shelf.

epifauna (n=36 total) and 0.1 m^2 van Veen grab samples for infauna (n=72 total at 2 per epifauna site). At each infauna sampling site, a second grab sample (n=72 total) was collected for characterizing carbon and nitrogen levels in surficial sediments, as well as grain size properties. Sampling effort was equally divided between experimental and control corridors and was consistent with the level of effort in 2001. Each of the experimental and control corridors was also surveyed using a Klein 5410 side scan sonar system to study possible changes in physical characteristics of the seafloor as a result of trawling. Preliminary observations indicate a very diverse epifaunal community (approximately 90 distinct taxa) on very-fine olive-gray sand at 60 m depth. The seafloor appears to be brushed smooth in the side scan imagery, probably due to sizable storm waves and strong tidal currents that regularly disturb the area. Occasional video deployments on the trawls indicated somewhat greater complexity. Final processing of the 2001 navigation data and biological samples is nearly complete and statistical analyses will be undertaken. Side scan processing is ongoing and will be followed by a quantitative change analysis.

Upon completion of the bottom trawl study, a reconnaissance survey of Bristol Bay habitats was undertaken using the Klein 5410 side scan sonar. This system is new technology that not only produces extremely high-resolution images of the seafloor, but also simultaneously gathers swath bathymetry data using interferometry. Approximately 1 megabyte (MB) of data are collected from the towfish each second. Prior to deployments in Alaska, the research team developed an improved software interface during laboratory testing and sea trials in Portsmouth Harbor, NH and Puget Sound, WA. The reconnaissance effort was centered on an 800 mi^2 area of central Bristol Bay that has never been hydrographically-surveyed by NOAA. Bathymetric data and imagery were collected along survey lines totaling nearly 600 linear miles (Fig. 3). In support of coordinated EFH characterization studies in the area, the reconnaissance survey intentionally crossed 18 RACE Division trawl survey stations and followed 78 mi of seabed previously classified using a *QTC View* single beam acoustic system. The survey also intersected six of the trawl study corridors (above) in order to provide a spatial context for these results. Overall, a great diversity of complex sand-bedforms and other geological features were encountered in the survey area (Fig. 3). The Klein system is being co-purchased with the NOAA Office of Coast Survey using accrued lease credits, and reconnaissance data will be used for nautical chart updates. The imagery will also be classified using supervised (“expert”) and unsupervised methods in an effort to identify large homeogenous regions that would be the basis for more systematic study of mobile gear effects.

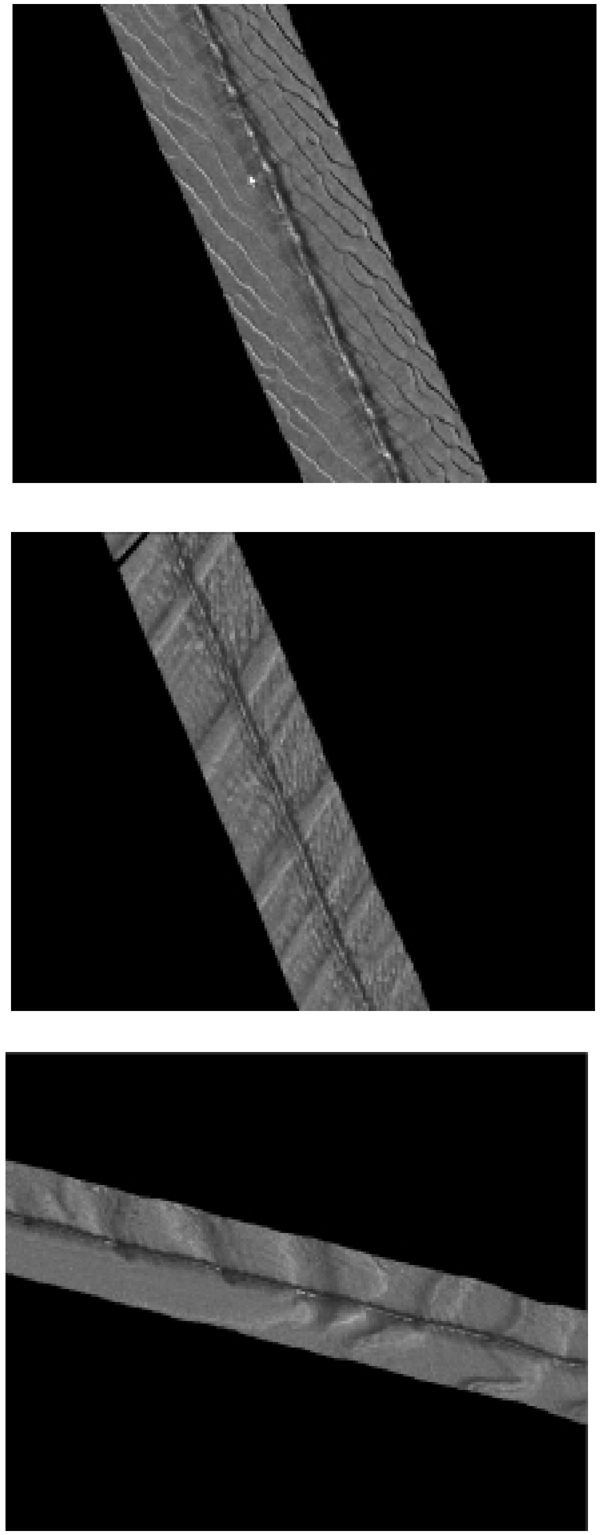

Figure 3. Representative side scan sonar images of sand bedforms acquired along Bristol Bay reconnaissance tracklines 2 and 3.

Habitat evaluation of major fishing grounds Principal investigators Jonathan Heifetz, Robert Stone, and Jeffrey Fujioka (Alaska Fisheries Science Center - ABL)

The Sustainable Fisheries Act of 1996 was passed to attain long term protection of essential fish habitat and specifically required that the NMFS minimize adverse impacts to essential fish habitat by fisheries that it manages. While considerable legal and administrative effort has been expended to meet the requirements of the Act, no specific measures to minimize fishery impacts have been enacted, and in Alaskan waters there has been little effort to observe the habitat where ongoing fisheries occur. The NMFS has limited knowledge of bottom habitat where major fisheries occur. Any regulatory measures adopted to minimize impacts without the knowledge of whether or where vulnerable habitat is at risk, may be ineffective or unnecessarily restrictive. This study, initiated in summer 2001, is an effort to attain such knowledge.

Portlock Bank, northeast of Kodiak, was chosen as the study area. Using the research submersible *Delta*, six sites were observed. Two were relatively flat sites on the north end of the Bank, one lightly fished and one in an area fished for Pacific ocean perch. Two were sloping sites along the eastern slope edge and two sites were toward the middle of the Bank, one fished for flatfish, the other lightly fished. Little evidence of trawling was observed on the low relief grounds of the continental shelf where perhaps the level bottom did not induce door gouging and there was a lack of boulders to be turned over or dragged. The most common epifauna were crinoids, small non-burrowing sea anemones, glass sponges, stylasterid corals and brittlestars. Occasional large boulders were located in depressions were the only anomaly in the otherwise flat seafloor. These depressions may have afforded some protection to fishing gear, as the glass sponges and stylasterid corals attached to these boulders were larger than were typically observed. In contrast, there was evidence of boulders turned over or dragged by trawling in the areas of the upper slope. The uneven bottom perhaps induced gouging by the trawl doors. The substrate was mostly small boulders, cobble, and gravel. In summary, for this very limited sample of the outer Portlock Bank, there was very little high relief benthic habitat that would be at risk to further fishing. No large corals and very few large sponges were seen. The extent past fishing may have contributed to this condition is not known.

Mapping of habitat features of major fishing grounds Principal investigators Jonathan Heifetz and Dean Courtney (Alaska Fisheries Science Center - ABL)

Little of the continental shelf and slope of the Alaska EEZ has been adequately described using geophysical and biological data. The objective of this study is to map limited areas of the Alaska EEZ for habitat characterization using state-of-the-art technology. During July 2002 approximately 500 km^2 of seafloor in the vicinity of the commercial fishing grounds near Yakutat were mapped using a high-resolution multibeam echosounder that included coregistered backscatter data. Survey depths ranged from about 100 m to 750 m. The area mapped is characterized as a formerly glaciated area of irregular seabed with mixed sediments (mostly sand, mud, and gravel) and high-relief areas consisting mostly of boulders. Combined with submersible observations and fishing effort data this mapping will allow habitat and geological characterization of the areas in relation to fishing intensity.

This mapping effort is complementary to similar mapping that was done last year on Portlock Bank northeast of Kodiak and in the vicinity of Cape Omaney in southeast Alaska. On Portlock Bank, approximately 900 km^2 of seafloor in the vicinity of the commercial fishing grounds were mapped. Survey depths ranged from less than 100 m to about 750 m. On Portlock Bank, analysis of the multibeam and backscatter data indicated at least a dozen macro- or meso-habitats. The megahabitats are the result of past glaciation and are presently being reworked into moderate (cm-m) relief features. Submarine gullies notch the upper slope and provide steep relief with alternating mud-covered and consolidated sediment exposures. The Cape Omaney site (180 km^2) ranged in depth from approximately 150 m - 300

m. This site is characterized as an irregular seabed with mixed sediments (mostly sand and gravel) and high-relief rocky outcrops and pinnacles.

Effects of bottom trawling on soft-bottom sea whip habitat in the central Gulf of Alaska. Principal Investigator - Robert P. Stone (Alaska Fisheries Science Center - ABL)

In April 1987 the North Pacific Fishery Management Council closed two areas around Kodiak Island, Alaska to bottom trawling and scallop dredging (Type 1 Areas). These areas were designated as important rearing habitat and migratory corridors for juvenile and molting crabs. The closures are intended to assist rebuilding severely depressed Tanner and red king crab stocks. In addition to crab resources, the closed areas and areas immediately adjacent to them, have rich stocks of groundfish including flathead sole, butter sole, Pacific halibut, arrowtooth flounder, Pacific cod, walleye pollock, and several species of rockfish.

These closures provide a rare opportunity to study the effects of an active bottom trawl fishery on soft-bottom, low-relief marine habitat because bottom trawling occurs immediately adjacent to the closed areas. In 1998 and 1999 the NMFS, Auke Bay Laboratory, initiated studies to determine the effects of bottom trawling on these soft-bottom habitats. Direct comparisons were possible between areas that were consistently trawled each year and areas where bottom trawling had been prohibited for 11 to 12 years. The proximity of the closed and open sites allowed for comparison of fine-scale infauna and epifauna diversity and abundance and microhabitat and community structure. During 2002 focus was on Data interpretation and analysis. Three manuscripts are in preparation from this work.

In June 2001 a study was initiated to investigate the immediate effects of intensive bottom trawling on soft-bottom habitat and in particular an area colonized by sea whips. Sea whip biological characteristics and their resistance to two levels of trawling were studied. Sea whips are highly visible and changes in their abundance can be readily quantified. Within the study site, at least two species of sea whips (*Halipterus* sp., and *Protoptilum* sp.) are present with densities up to 10 individuals per m^2. Sea whip beds provide vertical relief to this otherwise homogeneous, low relief habitat. This habitat may be particularly vulnerable since sea whips can be removed, dislodged, or broken by bottom fishing gear. Furthermore, since sea whips are believed to be long-lived, recolonization rates may be very slow.

The study plan consisted of three phases. In *Phase 1*, baseline data was collected. The *Delta* submersible was used to collect *in situ* videographic documentation of the seafloor along 20 predetermined transects within the study area. Additionally, a bottom sampler was deployed from the submersible tender vessel to collect sediment samples (n=42) from the seafloor. During *Phase 2,* a commercial trawler outfitted with a Bering Sea combination 107/138 net, mud gear, and two NETS High Lift trawl doors made a single trawl pass in one corridor of the study area and repetitively trawled (six trawl passes) a second corridor. A third corridor was the control and was not trawled. *Phase 3* repeated the videographic and sediment sampling (n= 42) following the trawling phase. A scientist on board the *Delta* observed the seafloor and verbally identified biota and evidence of trawling including damaged or dislodged biota and marks on the seafloor from the various components of the bottom trawl (e.g., trawl door furrows, and ground gear striations) in synchrony with the external cameras. Analyses of sediment, chemical, and infauna abundance and diversity was completed in 2002. Video analysis of epifauna data will be completed in January 2003.

Evaluation of acoustic technology for seabed classification Principal Investigator - Robert A. McConnaughey (RACE Division, Alaska Fisheries Science Center)

Detailed knowledge of seafloor properties is required to design effective studies of fishing gear impacts. Because benthic organisms have strong affinities for particular substrates, experimental areas must be carefully selected so as to minimize confounding effects. Moreover, substrate properties may help define areas of similar sensitivity to fishing gear, which would enable more systematic studies of natural and fishing gear disturbances. Acoustic technology is particularly suited to synoptic substrate mapping since quantitative data are collected rapidly and in a cost-effective manner. The *QTC View* seabed classification system (Quester Tangent Corporation, Sidney, B.C.; QTC) is capable of background data acquisition during routine survey operations. Nearly 8 million digitized echo returns from the seafloor were simultaneously collected at two frequencies (38 and 120 kHz) along a 9,000 nm trackline in the eastern Bering Sea during a 1999 hydroacoustic fishery survey by the *Miller Freeman*. Collaborative analyses with the QTC are continuing in order to develop an optimum seabed classification scheme for the eastern Bering Sea shelf. Once this is accomplished, it will be possible to evaluate the *QTC View* system for benthic habitat studies using standardized measures of fish and invertebrate abundance from annual trawl surveys. Preliminary analyses indicate the *QTC View* system is able to detect and map seabed types with distinct acoustic properties. However, in order to have *habitat* mapping utility, this acoustic variability must correspond to environmental features that influence the distribution of demersal and benthic biota.

Acoustic diversity directly represents substrate diversity. Surface roughness, acoustic impedance, and volume homogeneity influence echo returns from a vertical-incidence echo sounder and are characteristic of different seabed types. The standard QTC method uses a set of proprietary algorithms to extract features from individual echoes. Principal components analysis (PCA) reduces these features to three linear combinations that explain a large fraction of echo (seabed) variance. A three-factor cluster analysis then groups the echoes into distinct seabed types based on their acoustic diversity. Variation in continuous seabed properties is thus represented in discrete classes of seabed. The optimum scheme for any particular data set strikes a balance between high information content (i.e., many classes) and high confidence in the assigned class (e.g., if only one class).

Current clustering methods require significant user input to decide which class to split next and when to stop splitting. To overcome this subjectivity and develop a fully-automated objective process, a new application of Bayesian Information Theory was applied to guide the clustering process. However, because of the computational intensity of the Bayesian method and the very large size of the two data sets, only subsets of the data could be used for the analyses. Even so, over 200 CPU-hours were required to estimate the global minimum in the Bayesian Index indicating the true number of seabed classes for each data set. Significantly better methods for finding minima in multi-dimensional spaces have been developed in the study of inverse problems, particularly simulated annealing (SA), and further developments based on SA. In order to use the full data sets for clustering, we have been investigating use of SA in 2002 for efficiently identifying global minima in the Bayesian Index. Once this matter is resolved, objective large-scale seabed classification and mapping with vertical incidence echo sounders will be possible.

Living substrates in Alaska: distribution, abundance and species associations Principal Investigator - Patrick W. Malecha (Alaska Fisheries Science Center - ABL)

"Living substrates" have been identified as important marine habitat and are susceptible to impacts from fishing activities. In the Gulf of Alaska and Bering Sea, little is known about the distribution of deepwater living substrates such as, sponges (Phylum Porifera), sea anemones (Order Actiniaria), sea whips and sea pens (Order Pennatulacea), sea squirts (Class Ascidiacea), and ectoprocta (Phylum Bryozoa). In order to facilitate management practices that minimize fishery impacts to these living substrates, distributional maps were created based on National Marine Fisheries Service trawl survey data from 1975 through 2000. In general, the five groups of living substrates were observed along the continental shelf and upper slope in varying densities. Catch per unit effort (CPUE) of sponges was greatest along the Aleutian chain, while CPUE of sea squirts and ectoprocta was greatest in the Bering Sea. Large CPUEs of sea anemones, sea pens and sea whips were observed in both the Bering Sea and Gulf of Alaska. Species associations between living substrates and commercial fish and crab were also investigated. Flatfish were most commonly associated with sea squirts and ectoprocta; gadids with sea anemones, sea pens and sea whips; rockfish and Atka mackerel with sponges; and crab with sea anemones and sea squirts.

Growth and recruitment of an Alaskan shallow-water gorgonian. Principal Investigator - Robert P. Stone (Alaska Fisheries Science Center - ABL)

This study to examine the growth and recruitment of *Calcigorgia spiculifera*, a shallow-water Alaskan gorgonian continued in 2002. Two sites established in July 1999 were revisited during Cruise 02-11 aboard the NOAA Ship John N. Cobb. At these two sites, 30 of 35 colonies originally tagged in 1999 were relocated and video images recorded. These images will be digitized and growth determined from baseline images collected during the three previous years. A third study site was established in Kelp Bay, Baranof Island in 2000 where 30 colonies were tagged and images recorded. This site was unique in that it contained more than 1000 colonies, many of which were young (i.e., non-arborescent). At this site 18 of 30 colonies were relocated and video images were recorded. Branch samples were collected from untagged colonies at all three locations and will be examined microscopically to determine the gonadal morphology, gametogenesis, and reproductive schedule for this species. This will be the first work on the reproductive biology of any Alaskan coral species and should provide insights into the larval dynamics of gorgonians.

Growth rates of sponges in nearshore Alaska waters Principal Investigator - Lincoln Freese (Alaska Fishery Science Center - ABL)

Results of a recent study indicate that sponges in cold Alaska waters subjected to trawling impacts are slow to attain pre-trawl population densities or to repair damage caused by the trawl. Accordingly, this study was initiated during the 2001 field season to determine rates of sponge growth in Alaska waters. A small community of sponges located in shallow (<40 m) water in Seymour Canal, about 70 miles south of Juneau, Alaska, are being monitored on a long-term basis. Species present include *Geodia* sp., *Aphrocallistes* sp., and *Phykettia* sp. All three are known to occur in much deeper water on the continental shelf in the GOA. A total of 34 sponges were tagged in April, 2001, and video images of each specimen (with a measuring device in the field of view) were taken. The images will be analyzed with computer imaging software and compared with those obtained in the future. In April 2002 we removed cores samples of a known diameter from the individual tagged sponges to obtain information related to rates of regeneration of the sponges. Preliminary observations in September 2002 indicate that regeneration rates are highly variable among the species.

A second community of sponges located in the vicinity of Benjamin Is., Lynn Canal, Alaska, is also being monitored. Sponges were tagged, measured and cored in December 2001. Divers failed to relocate the reef upon which the sponges were located during a September 2002 cruise due to high levels of turbidity and low underwater visibility. We plan to return to the area in the winter of 2002-3, when visibility will be greater, and survey the area with a ROV before beginning followup diving operations.

Identification of Habitat Areas of Particular Concern (HAPC) Principal Investigator - Lincoln Freese (Alaska Fisheries Science Center - ABL)

Habitat features such as deep water seamounts and shallower pinnacles are often highly productive because of their physical oceanography, and host a rich variety of marine fauna. Perusal of oceanographic charts for the Gulf of Alaska reveals that these features are relatively rare. In summer of 1999 and 2000 dives were conducted on isolated pinnacles from the research submersible *Delta*. The pinnacle surveyed in 1999 is located on the continental shelf approximately 40 nautical miles south of Kodiak, Alaska and rises from a depth of about 40 meters to within 16 meters of the surface. The surrounding habitat is relatively featureless sand. The pinnacle hosted large aggregations of dusky rockfish, kelp greenling, and lingcod, similar to aggregations noted on a pinnacle located in the vicinity of the Sitka Pinnacles Marine Reserve. The pinnacle provides substrate for dense aggregations of macrophytic kelps beginning at the 20 meter isobath and continuing to the top of the pinnacle. These kelp beds may provide essential rearing habitat, as evidenced by the numerous juvenile fish (presumably rockfish) observed swimming among the kelp fronds. Although no evidence of fishing gear impacts were noted from the submersible, it is located SW of Kodiak Island adjacent to areas that are extensively trawled.

The pinnacles surveyed in 2000 were located in southeast Alaska west of Cape Omaney. The survey was designed to determine if the site met the criteria for designation as HAPC. The extent of the site was successfully charted from the *R/V Medeia.* The site measures approximately 400 x 600 m and contain a series of pinnacles. Maximum vertical relief is approximately 55 m, and water depths range between 201 and 256 m. Seven dives at the site were completed to document habitat and associated biota. An additional 5 dives were performed to collect specimens of red tree coral, sponges, and predatory starfish. The substrate is primarily bedrock and large boulders, most likely composed of mudstone, and provides abundant cover in the form of caves and interstices of various sizes. The epifaunal community is rich and diverse, much more so than the surrounding low-relief habitat. The largest epifauna were gorgonian red tree coral colonies and several species of sponges. These organisms are not evenly distributed at the study site. Review of the video and audio data may provide insights into habitat features or oceanographic processes affecting distributions of coral and sponges. Numerous species of fish, including several species of rockfish, are present in relatively large numbers. Redbanded rockfish and shortraker/rougheye rockfish were often associated with gorgonian coral colonies and at least one species of sponge. Also of interest was the presence of a pod of several hundred juvenile golden king crab on acorn barnacle shell hash on a sloping ledge on one of the pinnacles. We believe this is the first documented observation of juveniles of this species in the Gulf of Alaska. Water currents at the site are generally very strong, but are variable in both direction and strength depending on location. Numerous sections of derelict longline gear were observed on certain areas of the pinnacle, and damage to red tree corals was evident.

In 2001 a series of surveys were completed from the submersible *Delta* in areas of the GOA offshore from Seward southeastward to Yakutat, Alaska. Purpose of the surveys was to determine presence and relative abundance of red tree coral. Choice of survey sites was based on catch of red tree coral brought up in NMFS trawl survey tows. A number of those tows resulted in high catch rates (up to 5800 kg per tow) of coral. In 2001 a total of 18 submersible dives were made at some of these locations. Preliminary analysis of the data reveals that most of these sites were bereft of red tree coral. Three of the sites had small numbers of coral colonies attached to scattered boulders or rock substrates. Most sites were of low-relief with relatively fine substrate and provide relatively low levels of habitat complexity. One such site contained widely scattered boulders, some with attached sponges (*Aphrocallistes* sp.). Numerous juvenile (5-10 cm) rockfish were observed closely associated with the sponges. No juvenile rockfish were found on boulders devoid of sponges. Two dives were made at sites selected based on bathymetric features rather than past trawl survey results. The sites were located along the northwestern and southwestern edges of the Fairweather Grounds, and consisted of high-relief, rocky substrates. One site contained extremely high densities of very large red tree coral. The second site, although similar to the first, was devoid of red tree coral. Observations made during the 2001 survey indicate that red tree coral colonies in the areas studied exhibit patchy distribution and that abundance and distribution estimates of the species based on trawl survey data may be imprecise. In 2002 focus was on collection of data from the submersible videos.

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